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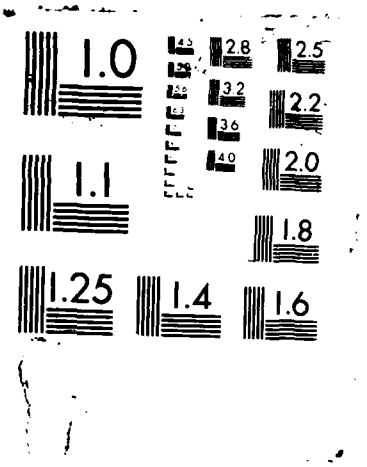
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Complex Sound Processing: An Interdisciplinary Approach

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Complex sounds describe most of the sounds that are perceived in our everyday life. However, most of our present knowledge about hearing is based on studying simple sounds. More knowledge is required about the neural processing of complex signals and about how animals process similar complex sounds. This proposal was to purchase two real-time, high-speed data acquisition computers similar to the one used for the human perception research at the Parmly Hearing Institute. These computers, MASSCOMPs, will be used to generate stimuli and to analyze behavioral and neurophysiological response for studies undertaken in the Animal Behavior and in the Auditory Physiology Laboratories of the Parmly Hearing Institute. The research in these projects involves the human perception of complex stimuli, and combined animal behavior and neurophysiological measures of some of these stimuli. The physiological studies include measurements within the eighth nerve and at the level of the cochlear

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nucleus of the auditory system. In order to relate these measures to the animal's ability to process these stimuli a series of animal behavioral studies are described. The addition of thes computer was essential for the full benefit of a multidisciplinary study of the processing of complex sounds.

Final Technical Progress Report on Complex Sound Processing: An Interdisciplinary Approach

DOD - University Research Instrumentation Program of the Air Force Office of Scientific Research

Project Investigators: W. A. Yost, R. R. Fay, and W. Shofner

Overview

The grant from the DOD instrumentation competition was used to purchase two Masscomp computer systems to aid in the physiological acoustic research in two of the laboratories of the Parmly Hearing Institute. A Progress Report for the entire Parmly Hearing Institute is attached as a supplement to this Technical Progress Report. Much of this progress was enhanced by the acquisition of the new computer systems.

One of the Masscomp systems was installed into the laboratory of Dr. William Shofner. Dr. Shofner studies the electrophysiological properties of single neurons in the auditory nerve and Cochlear Nucleus of rodents. Our previous experience with Masscomp computers allowed us to quickly integrate this system into the research projects being conducted in Dr. Shofner's laboratory. The computer controls and generates the sounds required for a particular study as well as acquires the neural responses and analyzes these data. The power of the Masscomp allows for the simultaneous operation of these tasks.

Dr. Shofner has developed a relatively new technique for analyzing auditory neural responses to changes in the intensity of acoustic signals. He has adopted analysis schemes from signal detection theory to process the neural train of impulses. This analysis allows for a much finer resolution of changes in neural responses resulting from changes in stimulus intensity than the older methods. Dr. Shofner is applying this technique to neurons in the auditory nerve and in the Cochlear Nucleus for broadband noise stimuli. He plans to develope this technique as a tool for a careful study of neural responses to more complex stimuli. The ability to provide a detailed look at neural changes to acoustic intensity will provide an important tool for unraveling the responses of the neurons within the complex neural networks of the Cochlear Nucleus.

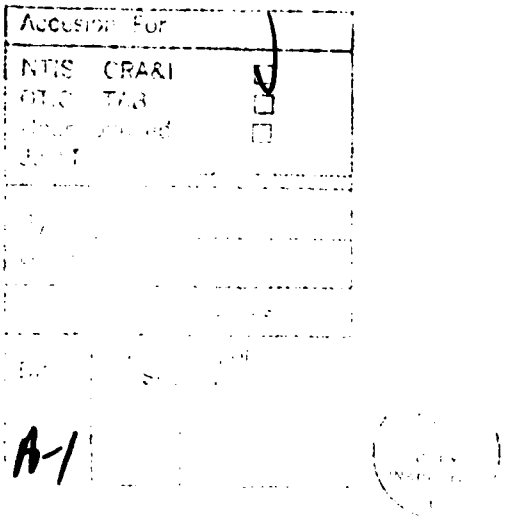
In a second project, Dr. Shofner is studying, at a variety of neural levels, the temporal properties of neuronal responses to complex acoustic stimuli which produce the sensation of pitch in humans. The pitch produced by these complex stimuli have not been adequately explained at the neuronal level. We feel that the neural complexity of the Cochlear Nucleus might provide the necessary ingredients for a physiological accounting of these pitches.

The second Masscomp system is being installed in the laboratory of Dr. Richard Fay. Dr. Fay studies the electrophysiological responses of the auditory nerve and higher auditory systems in fish. He uses complimentary behavioral studies to provide a neurophysiological explanation of the

processing of sound by a simple nervous system. The first study to be conducted using the new Masscomp involves a careful mapping of the directional sensitivity of auditory neurons to acoustic stimulation. Such directional sensitivity may underlay the fish's ability to localize sounds. The fish must use different mechanism for sound localization than mammals. Practically all animals locate sounds. By understanding how fish locate sounds we can provide valuable insights into how neural systems perform this complicated task. The experiment involves a careful integration of stimulus delivery and neural response monitoring. We are still perfecting the software and designing some of the acoustic hardware to carry out this difficult task. The development of this sophisticated software system will provide a powerful system for both Dr. Fay's and Dr. Shofner's laboratories. Because of the potential use of this software, we are being very careful to develop it thoroughly and fully.

Both computers have been integrated into the computer network at the Parmly Hearing Institute. The development of the new systems have benefited greatly from our experience with an existing Masscomp system. We have moved quickly to integrate the new systems into their laboratories and we are well on the way to using them to their maximum potential.

Additional information about the Institute, its research, its publications, and its personnel are provided in the attached Annual Progress Report.



This report is complete. The Annual Progress Report that is mentioned in the last paragraph is sent to DTIC every year.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